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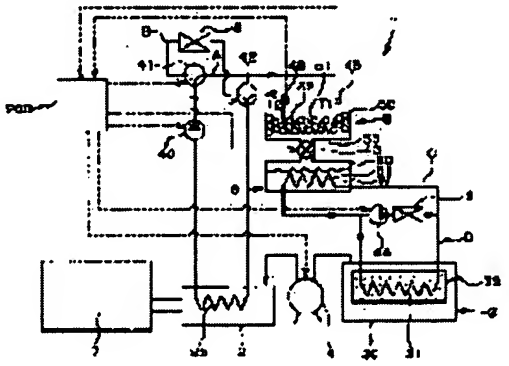
(54) FUEL CELL SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To carry out warming up of a cell without using any electric heater by heating the fuel cell using the heat of adsorption in an adsorber after starting power generation.
SOLUTION: When the starting switch of an automobile is set to ON, electric current is allowed to flow from a battery to an electricity controller 200, and a fuel pump 4, water pumps 40, 44 and an air pump start. Accordingly, air and hydrogen are supplied to a fuel cell 2 so as to start power generation. Simultaneously, heat exchanging fluid at about room temperature flows through the heat exchanging part 51 of an adsorbed 5 so as to cool absorbing agent 52 to adsorb water. Since the heat of adsorption caused by adsorption is discharged to the heat exchanging fluid, this heat exchanging fluid is heated. Therefore, an exit temperature T2 becomes higher than an entrance temperature T1. And by circulating heated heat exchanging fluid to a heat exchanging part 25 of the fuel cell 2 via a fluid circuit A, the fuel cell 2 is heated. In a word, the fuel cell 2 is quickly warmed up immediately after starting the fuel cell 2.



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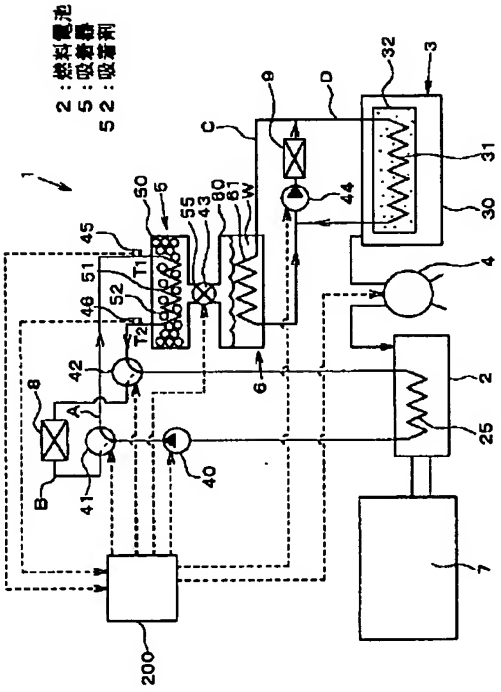
(54)【発明の名称】　燃料電池システム

(57)【要約】
【課題】　電気ヒータを使用せずに、燃料電池の暖機を行なう。
【解決手段】　燃料電池２の発電開始直後に、吸着器５の吸着剤５２に水を吸着させるとともに、この吸着による吸着熱を、熱交換流体を介して燃料電池２へ放出することにより、燃料電池２を暖機する。



【特許請求の範囲】
【請求項１】　燃料と酸化剤とを反応させて発電する燃料電池（２）と、
冷却状態にて吸着媒体を吸着し、加熱状態にて吸着媒体を脱着する多数の吸着剤（５２）を備えた吸着器（５）とを備え、
前記燃料電池（２）の発電開始直後に、前記吸着器（５）の前記吸着剤（５２）に前記吸着媒体を吸着させるとともに、この吸着による吸着熱により前記燃料電池（２）を加熱することを特徴とする燃料電池システム。
【請求項２】　前記燃料電池（２）の発電定常状態においては、前記燃料電池（２）が発生する熱により前記吸着器（５）を加熱して、前記吸着剤（５２）から前記吸着媒体を脱着させることを特徴とする請求項１に記載の燃料電池システム。
【請求項３】　前記吸着媒体を内蔵し、前記吸着器（５）にて前記吸着媒体を吸着するとき前記吸着媒体を蒸発させ、前記吸着器（５）にて前記吸着媒体を脱着するとき前記吸着媒体を凝縮させる凝縮蒸発器（６）が、前記吸着器（５）に連通して設けられ、
前記吸着器（５）と前記凝縮蒸発器（６）との連通部（５５）には、この連通部（５５）を開閉する開閉手段（４３）が設けられ、
前記燃料電池（２）の発電開始直後に、前記開閉手段（４３）にて前記連通部（５５）を開き、前記吸着剤（５２）から前記吸着媒体を脱着させた後に、前記開閉手段（４３）にて前記連通部（５５）を閉じることを特徴とする請求項２に記載の燃料電池システム。
【請求項４】　前記燃料電池（２）の前記熱を奪って前記燃料電池を冷却する冷却器（８）が設けられており、
前記吸着剤（５２）から前記吸着媒体が脱着されるときは、前記燃料電池（２）の前記熱を前記吸着器（５）の加熱に利用することで、前記燃料電池（２）が冷却され、前記吸着媒体を脱着させた後は、前記冷却器（８）により前記燃料電池（２）が冷却されることを特徴とする請求項２または３に記載の燃料電池システム。
【請求項５】　前記燃料電池（２）および前記吸着器（５）には、これら燃料電池（２）および吸着器（５）において吸熱または放熱する熱交換部（２５）および熱交換部（５１）が設けられ、
前記燃料電池（２）の前記熱交換部（２５）と前記吸着器（５）の前記熱交換部（５１）とを直列に接続するとともに、内部を熱交換流体が流れる流体回路（Ａ）が設けられ、
前記流体回路（Ａ）内部に熱交換流体を循環させるポンプ手段（４０）が、前記流体回路（Ａ）に設けられていることを特徴とする請求項１ないし４のいずれか１つに記載の燃料電池システム。
【請求項６】　前記吸着器（５）における前記吸着媒体の吸着および脱着を検出する検出手段（４５、４６、２００）と、
前記検出手段（４５、４６、２００）の検出信号に基づいて、前記開閉手段（４３）による前記連通部（５５）の開閉を制御する制御手段（２００）とを備えていることを特徴とする請求項３ないし５のいずれか１つに記載の燃料電池システム。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、燃料と酸化剤とを反応させて発電する燃料電池を備えた燃料電池システムに関するものである。
【０００２】
【従来の技術】通常、燃料電池システムにおいて燃料電池の発電開始直後では、燃料電池が室温程度に低温であるため、燃料と酸化剤との反応が良好に進まず、十分な発電効率が得られないものである。一方、燃料電池の発電の継続により、この燃料電池が発熱して温度が上昇すると、発電効率が向上する。また、燃料電池の温度が高くなりすぎると、電極等の構成材料が損傷する恐れがある。
【０００３】これに対して、特開平７－９４２０２号公報では、燃料電池を冷却する冷却水循環回路を設け、さらに、この回路の途中に、冷却水を加熱可能な電気ヒータを設けた燃料電池システムが提案されている。なお、電気ヒータには、燃料電池、または、バッテリから電力を供給するようになっている。これによれば、燃料電池の始動開始直後において、電気ヒータに通電して冷却水を加熱し、この加熱された冷却水により燃料電池を暖機できる。
【０００４】
【発明が解決しようとする課題】ところで、上記従来技術では、燃料電池から電気ヒータに電力を供給するにしても、バッテリから電気ヒータに電力を供給するようにしても、電力ヒータへ供給する電力分だけ余分に電力が必要となる、といった問題があった。本発明は上記問題に鑑みてなされたもので、電気ヒータを使用せずに、燃料電池の暖機を行なうことを目的とする。
【０００５】
【課題を解決するための手段】上記目的を達成するために、吸着剤（５２）が吸着媒体を吸着するとき、この吸着による吸着熱を放出することに着目して、請求項１ないし６に記載の発明では、燃料電池（２）の発電開始直後に、多数の吸着剤（５２）を備えた吸着器（５）における吸着熱により燃料電池（２）を加熱することを特徴としている。
【０００６】このような構成によれば、電気ヒータを使用することなく、上記吸着による吸着熱を利用して、燃料電池（２）の発電開始直後における燃料電池（２）の暖機を行なうことができる。よって、電気ヒータを使用しない分だけ省電力を図ることができ、燃料電池（２）

の電力を本来の目的に有効に利用できる。また、請求項２に記載の発明では、燃料電池（２）の発電定常状態においては、燃料電池（２）が発生する熱より吸着器（５）を加熱して、吸着器（５）の吸着剤（５２）から吸着媒体を脱着させている。ここで、次回の発電開始直後に燃料電池（２）を暖機するためには、吸着剤（５２）から吸着媒体を脱着させておく必要があるが、この脱着を、燃料電池（２）が発生する熱を利用して行なうことができるので、このときの電力使用を僅少にできる。

【０００７】また、燃料電池（２）が、自身の発生する熱を吸着器（５）に放出することで、この燃料電池（２）が異常に高温となることを防止でき、燃料電池（２）の損傷を抑制できる。また、請求項３に記載の発明では、吸着剤（５２）から吸着媒体を脱着させた後に、吸着器（５）と凝縮蒸発器（６）との連通部（５５）を開閉手段（４３）にて閉じるので、次回の発電開始時まで、吸着器（５）の吸着剤（５２）の脱着状態をそのまま維持できる。このため、次回の発電開始時に連通部（５５）を開くことにより、吸着器（５）における吸着媒体の吸着を良好に行なうことができ、燃料電池（２）の急速暖機を良好に行なうことができる。

【０００８】また、請求項４に記載の発明では、吸着剤（５２）から吸着媒体が脱着されるときは、燃料電池（２）の熱を吸着器（５）の加熱に利用することで、この燃料電池（２）が冷却され、吸着媒体を脱着させた後は冷却器（８）により燃料電池（２）が冷却されている。この結果、吸着媒体を脱着させた後も、燃料電池（２）が異常に高温となることを防止でき、燃料電池（２）の損傷を抑制できる。

【０００９】

【発明の実施の形態】以下、本発明を図に示す実施形態について説明する。

（第１の実施形態）図１は、本発明の燃料電池システム１を電源とする燃料電池自動車を示すものである。燃料電池システム１は、燃料（水素）と酸化剤（空気中の酸素）とを反応させて発電する燃料電池２と、燃料を貯蔵する燃料タンク３と、燃料タンク３内の水素を燃料電池２に送る燃料ポンプ４と、燃料電池２の急速暖機のための吸着器５と、吸着器５に連通する凝縮蒸発器６とを備えている。これらは全て、自動車の床下（車室外）に設けられている。そして、燃料電池２からの電力を、図示しないインバータやコンバータを介して、車両駆動用モータ７へ供給するようになっている。

【００１０】燃料電池２は、図２に示すように、炭素製の溝付コネクタ２１、白金触媒を添加した多孔質炭素からなる正極（カソード）２２、りん酸を含浸したシリコンカーバイドとフッ化炭素の混練物からなる電界質層２３、および、白金触媒を添加した多孔質炭素からなる負極（アノード）２４を、この順に積層したものからなる。溝付コネクタ２１のうち、正極２２に対向する面には、図２中紙面垂直方向に、多数の溝２１１が形成され、負極２４に対向する面には、図２中紙面左右方向に、多数の溝２１２が形成されている。

【００１１】そして、溝２１１には図示しないエアポンプから空気が供給され、溝２１２には燃料タンク３内の水素が燃料ポンプ４を介して供給されるようになっている。そして、積層方向端部の溝付コネクタ２１には、熱交換流体の流れる熱交換部２５が配置されている。燃料タンク３は、密閉容器３０の内部に、熱交換流体の流れる熱交換部３１と、この熱交換部３１の周囲に固定した水素貯蔵合金（燃料貯蔵合金）３２、例えば$LaNi_5H_6$とを収容してなる。水素貯蔵合金３２は、冷却するか、もしくは、圧力を上げることにより水素を吸蔵し、加熱するか、もしくは、圧力を下げることにより水素を放出するものである。本実施形態では、燃料ポンプ４により燃料タンク３内の圧力を下げて、水素貯蔵合金３２から水素を放出させている。なお、燃料電池２を使用するにつれて水素が消費されるため、定期的に水素貯蔵合金３２に水素を吸蔵させている。

【００１２】吸着器５は、密閉容器５０の内部に、熱交換流体の流れる熱交換部５１と、この熱交換部５１の周囲に固定した多数の粒状の吸着剤（例えばシリカゲル）５２とを収容してなる。吸着剤５２は、冷却されることにより吸着媒体（例えば水）を吸着し、加熱されることにより、その吸着媒体を脱着するものである。凝縮蒸発器６は、密閉容器６０の内部に、熱交換流体の流れる熱交換部６１と、吸着媒体としての水Ｗとを収容してなる。なお、凝縮蒸発器６の密閉容器６０と吸着器５の密閉容器５０との連通部５５には、この連通部５５を開閉する開閉弁（開閉手段）４３が設けてある。

【００１３】そして、燃料電池２の熱交換部２５と、吸着器５の熱交換部５１とは、流体回路Ａにより直列に接続され、燃料電池２の熱交換部２５と、室外熱交換器（冷却器）８とは、流体回路Ｂにより直列に接続されている。また、流体回路ＡおよびＢの重なる部位に設けたウォータポンプ（ポンプ手段）４０により、流体回路ＡおよびＢに熱交換流体を循環可能としてある。なお、三方切替弁４１、４２により、流体回路ＡまたはＢに、熱交換流体が循環するようになっている。

【００１４】また、室外熱交換器９と、凝縮蒸発器６の熱交換部６１とは、流体回路Ｃにより直列に接続され、室外熱交換器９と、燃料タンク３の熱交換部３１とは、流体回路Ｄにより直列に接続されている。また、流体回路ＣおよびＤの重なる部位に設けたウォータポンプ（ポンプ手段）４４により、流体回路ＣおよびＤに熱交換流体を循環可能としてある。

【００１５】また、吸着器５の熱交換部５１の入口部および出口部には、この入口部および出口部を流れる熱交換流体の温度T1 、T2 を検出する温度検出器（検出手

段）４５、４６が設けられている。ここで、本実施形態の燃料電池自動車には、電気制御装置（制御手段）２００が設けてあり、この電気制御装置２００は、燃料電池自動車の始動スイッチのオンオフの信号、および、温度検出器４５、４６の検出信号を入力されるとともに、これら入力信号に基づいて、上記した燃料ポンプ４、ウォータポンプ４０、４４、エアポンプへの通電のオンオフや、三方切替弁４１、４２、および、開閉弁４３の回動位置の切り替えを制御する。さらに、電気制御装置２００は、この他にも種々の公知の電気制御を行なうようになっている。

【００１６】また、燃料電池２とは独立して、図示しないバッテリが搭載されており、このバッテリは、自動車の運転時に所定容量充電されるようになっている。次に、上記構成において本実施形態の作動を説明する。なお、電気制御装置２００は、始動スイッチがオンされた後において、所定時間（例えば１分）毎に、上記温度Ｔ１、Ｔ２を検出するとともに、図４に示すステップＳ１～Ｓ３の判定を行なうようになっている。

【００１７】まず、自動車の始動スイッチがオンされると、上記バッテリから電気制御装置２００に通電されて、温度検出器４５、４６が温度Ｔ１、Ｔ２の検出を開始するとともに、図４に示す制御１が行なわれる。具体的に制御１とは、三方切替弁４１、４２の回動位置が図１中実線位置とされ、連通部５５を開くように開閉弁４３を回動させ、燃料ポンプ４、ウォータポンプ４０、４４、上記エアポンプに通電することである。

【００１８】これにより、燃料電池２の溝２１１に空気が供給されるとともに、溝２１２に水素が供給される。つまり、燃料電池２が発電を開始する。この結果、燃料電池２の負極２４表面にて水素（H_2）が水素イオン（H^+）と電子（e^-）に解離し、水素イオンは電解質層２３中を拡散して正極２２に移動し、電子は外部電気回路（車両駆動用モータ７）を通って正極２２に移動する。そして、正極２２においては、水素イオンおよび電子が酸素（O_2）と反応して水（H_2O）を生成する。このような化学反応を経て、燃料電池２の発電作用が得られる。

【００１９】同時に、室温（例えば２５℃）程度の熱交換流体が吸着器５の熱交換部５１を流れることにより、吸着剤５２が冷却されて水を吸着する。このとき、熱交換部５１を流れる熱交換流体へ、上記吸着による吸着熱が放出されるため、この熱交換流体が加熱される。つまり、図３（ａ）に示すように、入口温度Ｔ１よりも出口温度Ｔ２の方が高くなる。そして、加熱された熱交換流体を、流体回路Ａを経て、燃料電池２の熱交換部２５へ循環させることにより、熱交換部２５において加熱された熱交換流体が放熱し、燃料電池２を加熱する。

【００２０】これにより、始動スイッチをオンした直後、つまり、燃料電池２の発電開始直後において、燃料電池２を急速に暖機でき、燃料電池２の発電効率を急速に向上できる。よって、始動スイッチをオンした直後に、車両駆動用モータ７へ電力を供給できる。また、上記吸着熱を燃料電池２の加熱に利用することにより、燃料電池２の熱交換部２５から吸着器５の熱交換部５１へ供給される熱交換流体を冷却でき、吸着器５の吸着剤５２を冷却できるため、吸着器５における水の吸着を良好に続行させることができる。

【００２１】なお、始動スイッチをオンしてから所定時間経過後、具体的には、燃料電池２の発電が良好に行なわれるようになったとき、上記バッテリに替えて、燃料電池２により、電気制御装置２００への通電を行なう。同時に、上記バッテリの充電を開始する。また、上記吸着の開始により密閉容器５０および６０内の圧力が下がって、凝縮蒸発器６において水の蒸発が促進される。このとき、凝縮蒸発器６の熱交換部６１を流れる熱交換流体から、上記蒸発による蒸発潜熱を奪うため、この熱交換流体は冷却される。この冷却された熱交換流体を、流体回路Ｃを経て、室外熱交換器９に循環させることにより、冷却された熱交換流体が室外から吸熱する。このようにして、水が蒸発するときの蒸発潜熱を、熱交換流体を介して室外空気から奪うことができるため、水の蒸発を連続的に行なわせることができる。

【００２２】なお、水素貯蔵合金３２においては、水素を放出させるとき、その放出潜熱を周囲から奪うため、水素貯蔵合金３２は徐々に冷却されていくが、時間の経過に伴い冷却され過ぎると、水素貯蔵合金３２からの水素の放出が妨げられてしまう。これに対して、室外熱交換器９により、上記放出潜熱を室外空気から奪うようにしてあるので、水素の放出を良好に続行させることができる。

【００２３】そして、吸着器５における吸着が実行されているときは、吸着器５の熱交換部５１を流れる熱交換流体は、上述のように、入口温度Ｔ１よりも出口温度Ｔ２の方が高くなるが、吸着が完了したときは、入口温度Ｔ１≒出口温度Ｔ２となる（図３中時間ｔ１）。ここで、燃料電池２の発電が継続されて、燃料電池２が発電定常状態となると、この燃料電池２における上記化学反応の際の反応熱を発生（発熱）して、徐々に温度が高くなる。そして、吸着が完了した後に、吸着剤５２から水を脱着可能な温度となったとき（例えば１００℃となったとき）、この燃料電池２の熱交換部２５にて加熱された流体が、吸着完了状態の吸着器５の熱交換部５１を流れて放熱することにより、吸着器５が加熱されて吸着器５が水の脱着を開始する。

【００２４】この結果、吸着器５の熱交換部５１を流れる熱交換流体は、水の脱着による脱着熱を奪われて冷却されるため、入口温度Ｔ１の方が出口温度Ｔ２よりも高くなる。つまり、図４中ステップＳ１の判定結果がＹＥＳとなる。なお、この脱着時には、発熱する燃料電池２

を冷却して、燃料電池２の損傷を抑制する効果もある。

【００２５】同時に、凝縮蒸発器６において水の凝縮が開始される。凝縮蒸発器６の熱交換部６１は、凝縮による凝縮熱分の熱を、流体回路Ｃを流れる熱交換流体へ放出して熱交換流体を加熱し、この加熱された熱交換流体を、室外熱交換器９に循環させることにより、加熱された熱交換流体が室外空気へ放熱する。これにより、水の凝縮を連続的に行なうことができる。

【００２６】その後、吸着器５において、徐々に脱着完了状態に収束し、図３中時間ｔ3 においては、｜Ｔ2 －Ｔ1 ｜＜ε（ε≒０、例えばε＝０．５℃）、かつ、ｄ（Ｔ2 －Ｔ1 ）／ｄｔ＞０となる。つまり、図４中ステップＳ２およびＳ３の判定結果がＹＥＳとなる。このとき、吸着器５の吸着剤５２から水がほぼ全て脱着された状態（脱着完了状態）であると判断して、図４中制御２を行う。

【００２７】ここで、吸着状態から脱着状態へ入れ替わった直後（図３中時間ｔ2 ）においても、｜Ｔ2 －Ｔ1 ｜＜εとなるが、このときは、図３（ｃ）に示すように、ｄ（Ｔ2 －Ｔ1 ）／ｄｔ＜０であるため、ステップＳ３の判定結果がＮＯとなり、制御２は行なわれない。また、ｄ（Ｔ2 －Ｔ1 ）／ｄｔとは、図３（ｂ）に示すグラフの傾きのことである。

【００２８】具体的に制御２とは、開閉弁４３にて連通部５５を閉じるとともに、三方切替弁４１、４２の回動位置を図１中点線位置とするものである。これにより、流体回路Ｂを流れる熱交換流体を介して、燃料電池２の発生する熱を室外熱交換器８から室外空気へ放出でき、燃料電池２が異常に高温となることを抑制でき、燃料電池２の構成材料の損傷を抑制できる。

【００２９】なお、請求項３および４でいう、吸着剤５２から吸着媒体を脱着させた後とは、多少吸着媒体が吸着剤５２に残っている状態も含むこととする。また、温度検出器４５、４６、および、ステップＳ１ないしＳ３の判定を行なう電気制御装置２００により、請求項６でいう検出手段を構成し、この検出手段の検出信号に基づいて、開閉弁５５の回動位置の切り替えを行なう電気制御装置２００により、請求項６でいう制御装置を構成している。

【００３０】そして、吸着剤５２から水がほぼ全て脱着された後に、吸着器５と凝縮蒸発器６との連通部５５を開閉弁４３にて閉じるので、次回の発電開始時まで、吸着器５の吸着剤５２の脱着状態を維持できる。このため、次回の発電開始時に連通部５５を開くことにより、吸着器５における吸着媒体の吸着を良好に行なうことができ、燃料電池２の急速暖機を良好に行なうことができる。

【００３１】また、本実施形態では、上記吸着による吸着熱を利用して、燃料電池２の急速暖機を行なっているため、電気ヒータ等の熱を利用する従来技術に比べて、燃料電池２の急速暖機の際に使用する燃料電池２の電力量を低減できる。また、燃料電池２の発電定常状態においては、燃料電池２が発生する熱を利用して、吸着器５において吸着媒体を脱着させており、この脱着の際に使用する燃料電池２の電力量も少なくてすむ。

【００３２】また、吸着剤５２から吸着媒体が脱着されるときは、燃料電池２の熱を吸着器５の加熱に利用することで、この燃料電池２が冷却され、吸着媒体を脱着させた後は、室外熱交換器（冷却器）８により燃料電池２が冷却されている。この結果、燃料電池２の発電定常状態において、常に、燃料電池２が異常に高温となることを防止でき、燃料電池２を例えば１００～２００℃に保つことができる。よって、燃料電池２の損傷を抑制できる。

【００３３】なお、始動スイッチがオフされたときは、上記燃料ポンプ４、ポンプ４０、４４、上記エアポンプへの通電を停止する。なお、弁４１、４２、４３の回動位置は、制御２のままとする。

（第２の実施形態）本実施形態は、上記第１の実施形態における、凝縮蒸発器６、室外熱交換器９、燃料タンク３、流体回路Ｃ、Ｄ、ポンプ４４の部分の構造を、図５に示すように変形したものである。具体的に、燃料タンク３に第１熱交換部３１１および第２熱交換部３１２を設け、これら第１熱交換部３１１および第２熱交換部３１２の周囲に、水素貯蔵合金３２を配置してある。そして、第１熱交換部３１１と凝縮蒸発器６の熱交換部６１とを、流体回路Ｇにより直列に接続し、第２熱交換部３１２と室内熱交換器１０とを、流体回路Ｅにより直列に接続し、第２熱交換部３１２と室外熱交換器９とを、流体回路Ｆにより直列に接続してある。

【００３４】なお、流体回路Ｇには、流体回路Ｇに流体を循環させるウォータポンプ４４１が設けてあり、流体回路Ｅと流体回路Ｆとが重なる部位には、それぞれの流体回路Ｅ、Ｆに流体を循環させるウォータポンプ４４２が設けてある。また、三方切替弁４７、４８により、流体回路Ｅまたは流体回路Ｆに、熱交換流体が循環するようになっている。また、上記電気制御装置２００（図１参照）により、ウォータポンプ４４１、４４２への通電のオンオフや、三方切替弁４７、４８の回動位置の切り替えを制御する。

【００３５】本実施形態では、車室内の冷房のオンオフを切り替える冷房切り替え手段からの信号が、上記電気制御装置２００（図１参照）に入力されるようになっており、冷房がオンとされるときは、三方切替弁４７、４８の回動位置が、図５中実線位置とされ、冷房がオフとされるときは、三方切替弁４７、４８の回動位置が、図５中点線位置とされ。

【００３６】ここで、水素貯蔵合金３２においては、水素を放出させるとき、その放出潜熱を周囲から奪う。よって、水素貯蔵合金３２内部に設けた熱交換部３１２を

流れる熱交換流体を冷却し、この流体を室内熱交換器１０に循環させることにより、室内の冷房を行なうようになっている。そして、冷房がオンとされ、始動スイッチをオンした直後においては、凝縮蒸発器６における水の蒸発による蒸発潜熱により、凝縮蒸発器６の熱交換部６１を流れる熱交換流体を冷却し、この冷却された熱交換流体を、流体回路Ｇを経て第１熱交換部３１１へ流すことにより、水素貯蔵合金３２を冷却できる。

【００３７】従って、第２熱交換部３１２を流れる熱交換流体を、水素貯蔵合金３２の冷熱、および、上記放出潜熱により急速に冷却でき、この熱交換流体の冷熱を冷熱源とする室内熱交換器１０により、室内空気を急速に冷却できる。また、上記蒸発潜熱を上述のように使用することにより、水の蒸発を連続的に良好に行なうことができる。

【００３８】また、凝縮蒸発器６において水が凝縮するときは、流体回路Ｇを流れる熱交換流体を介して、その凝縮熱を水素貯蔵合金３２へ放出することにより、①水の凝縮を良好に続行させることができる。②水素貯蔵合金３２が過冷却されることを抑制でき、水素の放出を良好に続行できる。そして、上記ステップＳ１～Ｓ３の判定結果がＹＥＳとなったとき、ポンプ４４１への通電を停止する。

【００３９】なお、吸着器５や水素電池２等に係わる制御については、第１の実施形態と同様であるため、その説明を省略する。

（他の実施形態）上記第２の実施形態では、凝縮蒸発器６の熱交換部６１と、燃料タンク３の流体通３１２との間で流体を循環させていたが、凝縮蒸発器６の熱交換部６１と、室内熱交換器１０との間で流体を循環させるようにしてもよい。この場合、上記ステップＳ１の判定結果がＹＥＳであるとき、つまり、脱着が開始されるとき、凝縮蒸発器６の熱交換部６１と、室内熱交換器１０との間の流体の循環を停止するとよい。

【００４０】また、本実施形態では、吸着器５の熱交換部５１の入口、出口を流れる流体温度Ｔ１、Ｔ２、および、上記ステップＳ１～Ｓ３の判定を行なう電気制御装置２００を、請求項６でいう検出手段としていたが、これに限定されることはなく、他の種々の検出手段により、吸着器５における水の吸着および脱着を検出してもよい。

【００４１】また、上記ステップＳ１～Ｓ３の判定結果がＹＥＳのとき、制御２を実行していたが、これに限定されることはなく、他の種々の方法で、吸着器５の吸着剤５２の脱着が完了したことを検出した後、制御２を実行してもよい。

【図面の簡単な説明】

【図１】本発明の第１の実施形態に係わる燃料電池自動車の概略的な全体構成図である。

【図２】第１の実施形態に係わる燃料電池の概略的な斜視図である。

【図３】（ａ）は吸着器の熱交換部の入口温度Ｔ１ および出口温度Ｔ２ の時間ｔに対する変化を示すグラフ、（ｂ）は（Ｔ２ －Ｔ１ ）の時間ｔに対する変化を示すグラフ、（ｃ）はｄ（Ｔ２ －Ｔ１ ）／ｄｔの時間ｔに対する変化を示すグラフである。

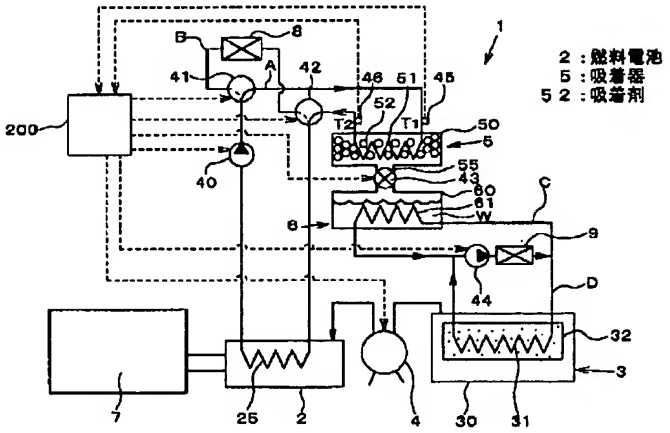
【図４】第１の実施形態に係わる作動を示すフローチャートである。

【図５】第２の実施形態に係わる燃料電池自動車の概略的な部分構成図である。

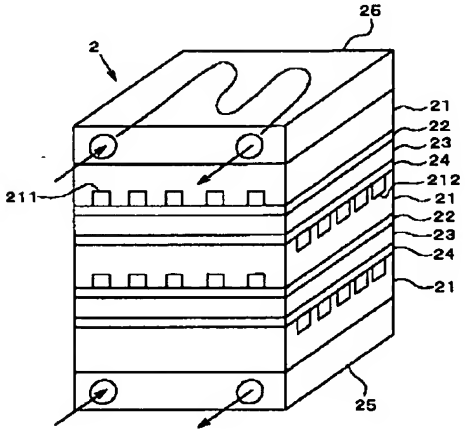
【符号の説明】

２…燃料電池、５…吸着器、５２…吸着剤。

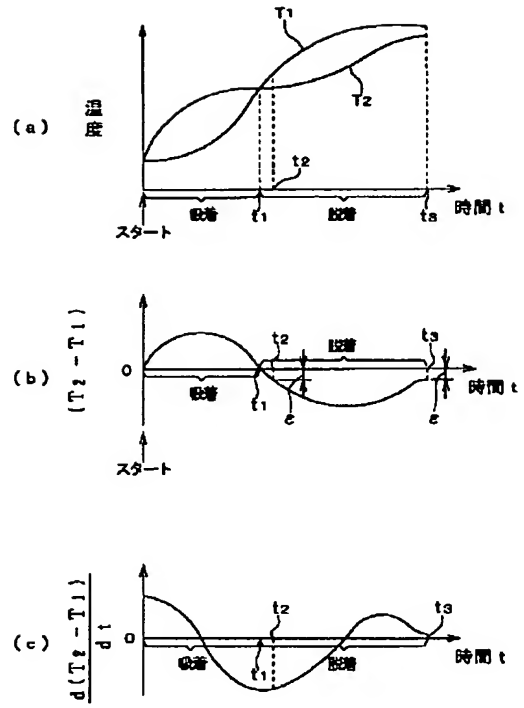
【図１】



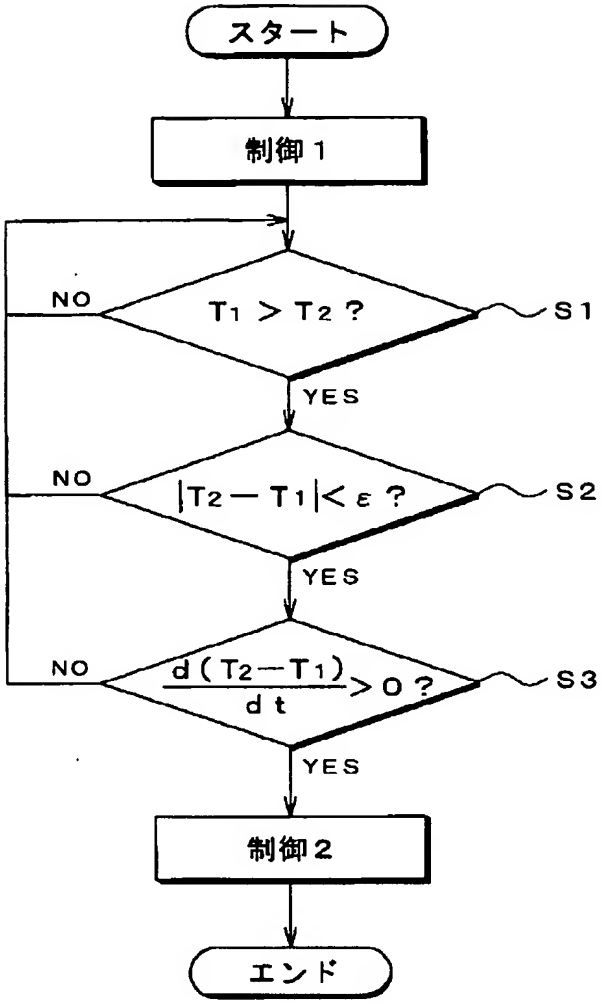
【図２】



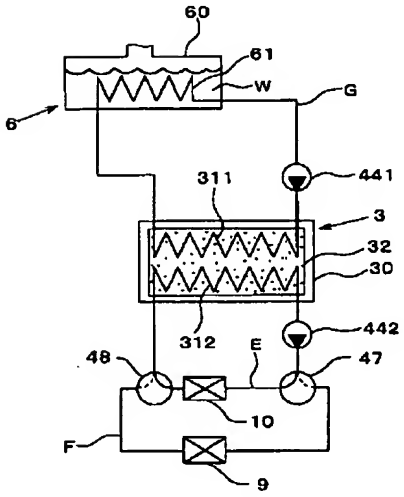
【図3】


(a)
温度
T1
T2
t2
時間 t
スタート
吸着
t1
脱着
t3
(b)
(T2－T1)
0
t2
t3
吸着
脱着
t1
ε
時間 t
スタート
(c)
d(T2－T1)
dt
0
t2
t3
吸着
t1
脱着
時間 t

【図4】


スタート
制御１
NO
T1 ＞ T2 ？
S1
YES
NO
|T2 － T1| ＜ ε ？
S2
YES
NO
d(T2－T1)/dt ＞ 0 ？
S3
YES
制御２
エンド

【図5】


60
61
W
G
6
311
441
3
32
30
312
E
442
48
47
10
F
9

CLAIMS

[Claim(s)]
[Claim 1] An adsorbent object is adsorbed in the state of cooling with the fuel cell (2) which a fuel and an oxidizer are made to react and is generated. While having the adsorber (5) equipped with the adsorbent (52) of a large number which carry out desorption of the adsorbent object in the state of heating and making said adsorbent object stick to said adsorbent (52) of said adsorber (5) immediately after generation-of-electrical-energy initiation of said fuel cell (2) The fuel cell system characterized by heating said fuel cell (2) with the heat of adsorption by this adsorption.
[Claim 2] The fuel cell system according to claim 1 characterized by heating said adsorber (5) with the heat which said fuel cell (2) generates in the generation-of-electrical-energy steady state of said fuel cell (2), and carrying out desorption of said adsorbent object from said adsorbent (52).
[Claim 3] When said adsorbent object is built in and said adsorbent object is adsorbed with said adsorber (5), said adsorbent object is evaporated. The condensation evaporator (6) which makes said adsorbent object condense when carrying out desorption of said adsorbent object with said adsorber (5) It is open for free passage and is prepared in said adsorber (5). In the free passage section (55) of said adsorber (5) and said condensation evaporator (6) A closing motion means (43) to open and close this free passage section (55) is established. Immediately after generation-of-electrical-energy initiation of said fuel cell (2) The fuel cell system according to claim 2 characterized by closing said free passage section (55) with said closing motion means (43) after carrying out desorption of said adsorbent object for said free passage section (55) from an aperture and said adsorbent (52) with said closing motion means (43).
[Claim 4] When the condensator (8) which takes said heat of said fuel cell (2), and cools said fuel cell is formed and desorption of said adsorbent object is carried out from said adsorbent (52) It is the fuel cell system according to claim 2 or 3 characterized by cooling said fuel cell (2) by said condensator (8) after cooling said fuel cell (2) and carrying out desorption of said adsorbent object by using said heat of said fuel cell (2) for heating of said adsorber (5).
[Claim 5] In said fuel cell (2) and said adsorber (5) In these fuel cells (2) and an adsorber (5), endoergic or the heat exchange section (25) which radiates heat, and the heat exchange section (51) are prepared. While connecting said heat exchange section (25) of said fuel cell (2), and said heat exchange section (51) of said adsorber (5) to a serial Claim 1 characterized by establishing the interior in a heat exchange fluid in a flowing fluid circuit (A), and forming a pump means (40) to circulate a heat exchange fluid inside said hydraulic circuit (A) in said hydraulic circuit (A) thru/or the fuel cell system of any one publication of four.
[Claim 6] Claim 3 characterized by having a detection means (45 46,200) to detect the adsorption of said adsorbent object and desorption in said adsorber (5), and the control means (200) which controls closing motion of said free passage section (55) by said closing motion means (43) based on the detecting signal of said detection means (45 46,200) thru/or the fuel cell system of any one publication of five.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell system equipped with the fuel cell which a fuel and an oxidizer are made to react and is generated.
[0002]
[Description of the Prior Art] Usually, since a fuel cell is low temperature just behind generation-of-electrical-energy initiation of a fuel cell in a fuel cell system at room temperature extent, the reaction of a fuel and an oxidizer does not progress good and sufficient generation efficiency is not acquired. On the other hand, if this fuel cell generates heat and temperature rises by continuation of a generation of electrical energy of a fuel cell, generation efficiency will improve. Moreover, when the temperature of a fuel cell becomes high too much, there is a possibility that components, such as an electrode, may be damaged.
[0003] On the other hand, in JP,7-94202,A, the fuel cell system which prepared the cooling water circulator which cools a fuel cell, and prepared further the electric heater which can heat cooling water in the middle of this circuit is proposed. In addition, power is supplied to an electric heater from a fuel cell or a dc-battery. According to this, immediately after start-up initiation of a fuel cell, it energizes to an electric heater, cooling water is heated, and a fuel cell can be warmed up with this heated cooling water.
[0004]
[Problem(s) to be Solved by the Invention] By the way, with the above-mentioned conventional technique, even if it supplied power to the electric heater from the fuel cell and supplied power to the electric heater from the dc-battery, there was a problem that power was needed for an excess by the power supplied to a power heater. This invention was not made in view of the above-mentioned problem, and aims at performing warming up of a fuel cell, without using an electric heater.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned object, when an adsorbent (52) adsorbs an adsorbent object, it is characterized by heating a fuel cell (2) paying attention to emitting the heat of adsorption by this adsorption with the heat of adsorption in the adsorber (5) which equipped claim 1 thru/or 6 with many adsorbents (52) immediately after generation-of-electrical-energy initiation of a fuel cell (2) by invention of a publication.
[0006] According to such a configuration, without using an electric heater, the heat of adsorption by the above-mentioned adsorption can be used, and warming up of the fuel cell (2) immediately after generation-of-electrical-energy initiation of a fuel cell (2) can be performed. Therefore, only the part which does not use an electric heater can plan power saving, and can use the power of a fuel cell (2) effective in the original object. Moreover, in invention according to claim 2, in the generation-of-electrical-energy steady state of a fuel cell (2), an adsorber (5) is heated and desorption of the adsorbent object is carried out from the adsorbent (52) of an adsorber (5) from the heat which a fuel cell (2) generates. Here, in order to warm up a fuel cell (2) immediately after next generation-of-electrical-

energy initiation, it is necessary to carry out desorption of the adsorbent object from an adsorbent (52) . but, and since this desorption can be performed using the heat which a fuel cell (2) generates, the power activity at this time can be made small.

[0007] Moreover, it can prevent that this fuel cell (2) serves as an elevated temperature unusually, and breakage on a fuel cell (2) can be controlled because a fuel cell (2) emits the heat which self generates to an adsorber (5). Moreover, since the free passage section (55) of an adsorber (5) and a condensation evaporator (6) is closed with a closing motion means (43) after carrying out desorption of the adsorbent object from an adsorbent (52), the desorption condition of the adsorbent (52) of an adsorber (5) is maintainable in invention according to claim 3, as it is till next generation-of-electrical-energy initiation. For this reason, at the time of next generation-of-electrical-energy initiation, by open Lycium chinense, an adsorbent object [in / for the free passage section (55) / an adsorber (5)] can be adsorbed good, and rapid warming up of a fuel cell (2) can be performed good.

[0008] Moreover, in invention according to claim 4, when desorption of the adsorbent object is carried out from an adsorbent (52), it is using the heat of a fuel cell (2) for heating of an adsorber (5), this fuel cell (2) is cooled, and after carrying out desorption of the adsorbent object, the fuel cell (2) is cooled by the condensator (8). Consequently, even after carrying out desorption of the adsorbent object, it can prevent that a fuel cell (2) serves as an elevated temperature unusually, and breakage on a fuel cell (2) can be controlled.

[0009]

[Embodiment of the Invention] Hereafter, the operation gestalt which shows this invention in drawing is explained.

(1st operation gestalt) Drawing 1 shows the fuel cell powered vehicle which uses the fuel cell system 1 of this invention as a power source. The fuel cell system 1 is equipped with the fuel cell 2 which a fuel (hydrogen) and an oxidizer (oxygen in air) are made to react, and is generated, the fuel tank 3 in which a fuel is stored, the fuel pump 4 which sends the hydrogen in a fuel tank 3 to a fuel cell 2, the adsorber 5 for rapid warming up of a fuel cell 2, and the condensation evaporator 6 which is open for free passage to an adsorber 5. These are all prepared in the under floor (vehicle outdoor) of an automobile. And the power from a fuel cell 2 is supplied to the motor 7 for car actuation through the inverter and converter which are not illustrated.

[0010] A fuel cell 2 consists of what carried out the laminating of the fluting connector 21 made from carbon, the positive electrode (cathode) 22 which consists of porous carbon which added the platinum catalyst, electric-field **** 23 which consists of a kneading object of silicon carbide and carbon fluoride which sank in phosphoric acid, and the negative electrode (anode) 24 which consists of porous carbon which added the platinum catalyst to this order, as shown in drawing 2 . Many slots 211 are formed by the field which counters a positive electrode 22 among the fluting connectors 21 at the space perpendicular direction in drawing 2 , and many slots 212 are formed in the field which counters a negative electrode 24 at the space longitudinal direction in drawing 2 at it.

[0011] And air is supplied to a slot 211 from the air pump which is not illustrated, and the hydrogen in a fuel tank 3 is supplied to a slot 212 through a fuel pump 4. And the heat exchange section 25 in which a heat exchange fluid flows is arranged at the fluting connector 21 of the direction edge of a laminating. A fuel tank 3 is the hydrogen storage material 32 five H6 fixed to the interior of a well-closed container 30 around the heat exchange section 31 in which a heat exchange fluid flows, and this heat exchange section 31 (fuel storage alloy), for example, LaNi. It comes to hold. A hydrogen storage material 32 emits hydrogen by carrying out occlusion of the hydrogen, and heating it, or lowering a pressure by cooling or raising a pressure. The pressure in a fuel tank 3 is lowered with a fuel pump 4, and hydrogen is made to emit from a hydrogen storage material 32 with this operation gestalt. In addition, since hydrogen is consumed as a fuel cell 2 is used, occlusion of the hydrogen is periodically carried out to a hydrogen storage material 32.

[0012] An adsorber 5 comes to hold the heat exchange section 51 in which a heat exchange fluid flows, and the adsorbent (for example, silica gel) 52 of the shape of a grain of a large number fixed to the perimeter of this heat exchange section 51 in the interior of a well-closed container 50. By being cooled,

an adsorbent 52 adsorbs an adsorbent object (for example, water), and carries out desorption of the adsorbent object by being heated. The condensation evaporator 6 comes to hold the heat exchange section 61 in which a heat exchange fluid flows, and the water W as an adsorbent object in the interior of a well-closed container 60. In addition, the closing motion valve (closing motion means) 43 which opens and closes this free passage section 55 is formed in the free passage section 55 of the well-closed container 60 of the condensation evaporator 6, and the well-closed container 50 of an adsorber 5.

[0013] And the heat exchange section 25 of a fuel cell 2 and the heat exchange section 51 of an adsorber 5 are connected to a serial by the hydraulic circuit A, and the heat exchange section 25 of a fuel cell 2 and an outdoor heat exchanger (condensator) 8 are connected to the serial by the hydraulic circuit B. Moreover, circulation of a heat exchange fluid is enabled at hydraulic circuits A and B with Water pump (pump means) 40 formed in the part with which hydraulic circuits A and B lap. In addition, a heat exchange fluid circulates to hydraulic circuits A or B by the three-way-type selector valves 41 and 42.

[0014] Moreover, an outdoor heat exchanger 9 and the heat exchange section 61 of the condensation evaporator 6 are connected to a serial by the hydraulic circuit C, and an outdoor heat exchanger 9 and the heat exchange section 31 of a fuel tank 3 are connected to the serial by the hydraulic circuit D. Moreover, circulation of a heat exchange fluid is enabled at hydraulic circuits C and D with Water pump (pump means) 44 formed in the part with which hydraulic circuits C and D lap.

[0015] Moreover, the temperature T1 of the heat exchange fluid which flows this inlet-port section and the outlet section in the inlet-port section of the heat exchange section 51 and the outlet section of an adsorber 5 and T2 The thermometric elements (detection means) 45 and 46 to detect are formed. Here, the electrical control unit (control means) 200 is formed, and to it, it controls turning on and off of the energization to the above-mentioned fuel pump 4, Water pumps 40 and 44, and an air pump, and the change of the rotation location of the three-way-type selector valves 41 and 42 and the closing motion valve 43 based on these input signals while the signal of turning on and off of the starting switch of a fuel cell powered vehicle and the detecting signal of thermometric elements 45 and 46 are inputted into this electrical control unit 200 by the fuel cell powered vehicle of this operation gestalt. Furthermore, in addition to this, an electrical control unit 200 performs various well-known electric control.

[0016] Moreover, in a fuel cell 2, the dc-battery which is not illustrated is carried independently and predetermined capacity charge of this dc-battery is carried out at the time of operation of an automobile. Next, actuation of this operation gestalt is explained in the above-mentioned configuration. In addition, it sets, after a starting switch is turned on, and an electrical control unit 200 is the above-mentioned temperature T1 and T2 in every predetermined time (for example, 1 minute). While detecting, steps S1-S3 shown in drawing 4 are judged.

[0017] First, when the starting switch of an automobile is turned on, it energizes from the above-mentioned dc-battery to an electrical control unit 200, and thermometric elements 45 and 46 are temperature T1 and T2. While starting detection, control 1 shown in drawing 4 is performed. In control 1, it is the rotation location of the three-way-type selector valves 41 and 42 being made into a drawing 1 R>1 solid line position, rotating the closing motion valve 43 so that the free passage section's 55 may be opened, and energizing to a fuel pump 4, Water pumps 40 and 44, and the above-mentioned air pump concretely.

[0018] Thereby, while air is supplied to the slot 211 of a fuel cell 2, hydrogen is supplied to a slot 212. That is, a fuel cell 2 starts a generation of electrical energy. Consequently, hydrogen (H2) dissociates into a hydrogen ion (H+) and an electron (e-) on negative-electrode 24 front face of a fuel cell 2, a hydrogen ion diffuses the inside of the electrolyte layer 23, and moves to a positive electrode 22, and an electron moves to a positive electrode 22 through an external electrical circuit (motor 7 for car actuation). And in a positive electrode 22, a hydrogen ion and an electron react with oxygen (O2), and generate water (H2 O). A generation-of-electrical-energy operation of a fuel cell 2 is acquired through such a chemical reaction.

[0019] Simultaneously, when the heat exchange fluid of room temperature (for example, 25 degrees C) extent flows the heat exchange section 51 of an adsorber 5, an adsorbent 52 is cooled and water is adsorbed. Since the heat of adsorption by the above-mentioned adsorption is emitted to the heat

exchange fluid which flows the heat exchange section 51 at this time, this heat exchange fluid is heated. That is, as shown in drawing 3 (a), it is inlet temperature T1. Outlet temperature T2 The direction becomes high. And by circulating the heated heat exchange fluid to the heat exchange section 25 of a fuel cell 2 through a hydraulic circuit A, the heat exchange fluid heated in the heat exchange section 25 radiates heat, and a fuel cell 2 is heated.

[0020] Thereby, immediately after turning on a starting switch that is, a fuel cell 2 can be quickly warmed up immediately after generation-of-electrical-energy initiation of a fuel cell 2, and the generation efficiency of a fuel cell 2 can be improved quickly. Therefore, power can be supplied to the motor 7 for car actuation immediately after turning on a starting switch. Moreover, since the heat exchange fluid supplied to the heat exchange section 51 of an adsorber 5 from the heat exchange section 25 of a fuel cell 2 by using the above-mentioned heat of adsorption for heating of a fuel cell 2 can be cooled and the adsorbent 52 of an adsorber 5 can be cooled, adsorption of the water in an adsorber 5 can be continued good.

[0021] In addition, after predetermined time progress, after turning on a starting switch, when a generation of electrical energy of a fuel cell 2 comes to be performed good, it changes to the above-mentioned dc-battery, and, specifically, a fuel cell 2 performs energization to an electrical control unit 200. Simultaneously, charge of the above-mentioned dc-battery is started. Moreover, the pressure in a well-closed container 50 and 60 falls by initiation of the above-mentioned adsorption, and evaporation of water is promoted in the condensation evaporator 6. In order to take the latent heat of vaporization by the above-mentioned evaporation from the heat exchange fluid which flows the heat exchange section 61 of the condensation evaporator 6 at this time, this heat exchange fluid is cooled. The cooled heat exchange fluid carries out endoergic from outdoor by making an outdoor heat exchanger 9 circulate through this cooled heat exchange fluid through a hydraulic circuit C. Thus, since the latent heat of vaporization in case water evaporates can be taken from outdoor air through a heat exchange fluid, water can be evaporated continuously.

[0022] In addition, in a hydrogen storage material 32, when making hydrogen emit, in order to take the bleedoff latent heat from a perimeter, the hydrogen storage material 32 is cooled gradually, but if cooled too much in connection with the passage of time, bleedoff of the hydrogen from a hydrogen storage material 32 will be barred. On the other hand, by the outdoor heat exchanger 9, since the above-mentioned bleedoff latent heat is taken from outdoor air, bleedoff of hydrogen can be continued good.

[0023] And the heat exchange fluid which flows the heat exchange section 51 of an adsorber 5 when adsorption in an adsorber 5 is performed is inlet temperature T1 as mentioned above. Outlet temperature T2 Although the direction became high, when adsorption is completed, it is the inlet temperature T1 ** outlet temperature T2. It becomes (time amount t1 in drawing 3). Here, if a generation of electrical energy of a fuel cell 2 will be continued and a fuel cell 2 will be in a generation-of-electrical-energy steady state, heat of reaction in the case of the above-mentioned chemical reaction in this fuel cell 2 will be generated (generation of heat), and temperature will become high gradually. And when it becomes the temperature in which desorption is possible from an adsorbent 52 about water after adsorption was completed, and the fluid heated in the heat exchange section 25 of this fuel cell 2 (for example, when it becomes 100 degrees C) flows and radiates heat in the heat exchange section 51 of the adsorber 5 of the completion condition of adsorption, an adsorber 5 is heated and an adsorber 5 starts the desorption of water.

[0024] Consequently, since the desorption heat by the desorption of water is taken and it is cooled, the heat exchange fluid which flows the heat exchange section 51 of an adsorber 5 is inlet temperature T1. The direction is outlet temperature T2. It becomes high. That is, the judgment result of step S1 in drawing 4 serves as YES. In addition, at the time of this desorption, the fuel cell 2 generating heat is cooled and there is effectiveness which controls breakage on a fuel cell 2.

[0025] Simultaneously, condensation of water is started in the condensation evaporator 6. The heated heat exchange fluid radiates heat to outdoor air by the heat exchange section 61 of the condensation evaporator 6 emitting the heat for the heat of condensation by condensation to the heat exchange fluid which flows a hydraulic circuit C, heating a heat exchange fluid, and making an outdoor heat exchanger

9 circulate through this heated heat exchange fluid. Thereby, water can be condensed continuously.
[0026] Then, in an adsorber 5, it converges on a desorption completion condition gradually, and is the time amount t3 in drawing 3 . It sets and is set to <epsilon (epsilon**0, for example, epsilon= 0.5 degrees C) and d (T2-T1)/dt>0. [|T2-T1 |] That is, the judgment result of steps S2 and S3 in drawing 4 serves as YES. At this time, it judges that it is in the condition (desorption completion condition) that desorption of the water was mostly carried out altogether from the adsorbent 52 of an adsorber 5, and control 2 among drawing 4 is performed.
[0027] Here, although set to |T2-T1 |<epsilon immediately after exchanging from an adsorbed state to a desorption condition (time amount t2 in drawing 3), since it is d(T2-T1)/dt<0 at this time as shown in drawing 3 (c), the judgment result of step S3 serves as NO, and control 2 is not performed. Moreover, it is the thing of the inclination of the graph shown in drawing 3 (b) in d (T2-T1)/dt.
[0028] Concretely, control 2 makes the rotation location of the three-way-type selector valves 41 and 42 the drawing 1 middle point line position while closing the free passage section 55 with the closing motion valve 43. Thereby, through the heat exchange fluid which flows a hydraulic circuit B, the heat which a fuel cell 2 generates can be emitted to outdoor air from an outdoor heat exchanger 8, it can control that a fuel cell 2 serves as an elevated temperature unusually, and breakage on the component of a fuel cell 2 can be controlled.
[0029] In addition, after carrying out desorption of the adsorbent object from the adsorbent 52 as used in the field of claims 3 and 4, an adsorbent object presupposes some that the condition of remaining in the adsorbent 52 is also included. Moreover, the electrical control unit 200 which performs thermometric elements 45 and 46 and step S1 thru/or the judgment of S3 constitutes the detection means as used in the field of claim 6, and the electrical control unit 200 which changes the rotation location of the closing motion valve 55 constitutes the control unit as used in the field of claim 6 based on the detecting signal of this detection means.
[0030] And since the free passage section 55 of an adsorber 5 and the condensation evaporator 6 is closed with the closing motion valve 43 after desorption of the water is mostly carried out altogether from an adsorbent 52, the desorption condition of the adsorbent 52 of an adsorber 5 is maintainable till next generation-of-electrical-energy initiation. For this reason, at the time of next generation-of-electrical-energy initiation, by open Lycium chinense, an adsorbent object [in / for the free passage section 55 / an adsorber 5] can be adsorbed good, and rapid warming up of a fuel cell 2 can be performed good.
[0031] Moreover, with this operation gestalt, since rapid warming up of a fuel cell 2 is performed using the heat of adsorption by the above-mentioned adsorption, compared with the conventional technique of using heat, such as an electric heater, the electric energy of the fuel cell 2 used in the case of rapid warming up of a fuel cell 2 can be reduced. Moreover, in the generation-of-electrical-energy steady state of a fuel cell 2, using the heat which a fuel cell 2 generates, there is also little electric energy of the fuel cell 2 which is made to carry out desorption of the adsorbent object in an adsorber 5, and is used in the case of this desorption, and it ends.
[0032] Moreover, when desorption of the adsorbent object is carried out from an adsorbent 52, after being using the heat of a fuel cell 2 for heating of an adsorber 5, cooling this fuel cell 2 and carrying out desorption of the adsorbent object, the fuel cell 2 is cooled by the outdoor heat exchanger (condensator) 8. Consequently, in the generation-of-electrical-energy steady state of a fuel cell 2, it can always prevent that a fuel cell 2 serves as an elevated temperature unusually, and a fuel cell 2 can be kept at 100-200 degrees C. Therefore, breakage on a fuel cell 2 can be controlled.
[0033] In addition, when a starting switch is turned off, the energization to the above-mentioned fuel pump 4, pumps 40 and 44, and the above-mentioned air pump is stopped. In addition, the rotation location of valves 41, 42, and 43 is considered as as [control 2].
(2nd operation gestalt) This operation gestalt transforms the structure of the parts of the condensation evaporator 6 in the operation gestalt of the above 1st, an outdoor heat exchanger 9, a fuel tank 3, hydraulic circuits C and D, and a pump 44, as shown in drawing 5 . Concretely, the 1st heat exchange section 311 and the 2nd heat exchange section 312 are formed in a fuel tank 3, and the hydrogen storage

material 32 is arranged around these 1st heat exchange section 311 and the 2nd heat exchange section 312. And the 1st heat exchange section 311 and the heat exchange section 61 of the condensation evaporator 6 are connected to a serial by the hydraulic circuit G, the 2nd heat exchange section 312 and indoor heat exchanger 10 are connected to a serial by the hydraulic circuit E, and the 2nd heat exchange section 312 and an outdoor heat exchanger 9 are connected to the serial by the hydraulic circuit F.
[0034] In addition, Water pump 441 made to circulate through a fluid is formed in the hydraulic circuit G at the hydraulic circuit G, and Water pump 442 which makes each hydraulic circuit E and F circulate through a fluid is formed in the part with which a hydraulic circuit E and a hydraulic circuit F lap. Moreover, a heat exchange fluid circulates to a hydraulic circuit E or a hydraulic circuit F by the three-way-type selector valves 47 and 48. Moreover, turning on and off of energization and the change of the rotation location of the three-way-type selector valves 47 and 48 to Water pumps 441 and 442 are controlled by the above-mentioned electrical control unit 200 (refer to drawing 1).
[0035] With this operation gestalt, when the rotation location of the three-way-type selector valves 47 and 48 is made into the drawing 5 solid line position when the signal from the cooling change means which changes turning on and off of cooling of the vehicle interior of a room is inputted into the above-mentioned electrical control unit 200 (refer to drawing 1) and cooling is set to ON, and cooling is set to OFF, let the rotation location of the three-way-type selector valves 47 and 48 be a drawing 5 R>5 middle-point line position.
[0036] Here, in a hydrogen storage material 32, when making hydrogen emit, the bleedoff latent heat is taken from a perimeter. Therefore, indoor cooling is performed by cooling the heat exchange fluid which flows the heat exchange section 312 prepared in the hydrogen storage material 32 interior, and making indoor heat exchanger 10 circulate through this fluid. And a hydrogen storage material 32 can be cooled immediately after setting cooling to ON and turning on a starting switch by cooling the heat exchange fluid which flows the heat exchange section 61 of the condensation evaporator 6, and pouring this cooled heat exchange fluid to the 1st heat exchange section 311 through a hydraulic circuit G with the latent heat of vaporization by evaporation of the water in the condensation evaporator 6.
[0037] Therefore, the heat exchange fluid which flows the 2nd heat exchange section 312 can be quickly cooled with the cold energy and the above-mentioned bleedoff latent heat of a hydrogen storage material 32, and indoor air can be quickly cooled by the indoor heat exchanger 10 which makes a heat sink cold energy of this heat exchange fluid. Moreover, water can be continuously evaporated to fitness by using the above-mentioned latent heat of vaporization as mentioned above.
[0038] Moreover, when water condenses in the condensation evaporator 6, condensation of ** water can be continued good through the heat exchange fluid which flows a hydraulic circuit G by emitting the heat of condensation to a hydrogen storage material 32. ** It can control that a hydrogen storage material 32 is supercooled, and bleedoff of hydrogen can be continued good. And when the judgment result of the above-mentioned steps S1-S3 is set to YES, the energization to a pump 441 is stopped.
[0039] In addition, about the control concerning an adsorber 5 or hydrogen cell 2 grade, since it is the same as that of the 1st operation gestalt, the explanation is omitted.
(Other operation gestalten) Although the fluid was circulated between the heat exchange section 61 of the condensation evaporator 6, and ****** 312 of a fuel tank 3, you may make it circulate a fluid with the operation gestalt of the above 2nd between the heat exchange section 61 of the condensation evaporator 6, and indoor heat exchanger 10. In this case, when the judgment result of the above-mentioned step S1 is YES (i.e., when desorption is started), it is good to suspend circulation of the fluid between the heat exchange section 61 of the condensation evaporator 6 and indoor heat exchanger 10.
[0040] Moreover, although the electrical control unit 200 which performs the flowing fluid temperature T1, T2, and the judgment of the above-mentioned steps S1-S3 for the inlet port of the heat exchange section 51 of an adsorber 5 and an outlet was made into the detection means as used in the field of claim 6 with this operation gestalt, it is not limit to this and other various detection means may detect the adsorption of water and desorption in an adsorber 5.
[0041] Moreover, it is not limited to this, when the judgment result of the above-mentioned steps S1-S3 was YES, control 2 was performed, but it is other various approaches, and control 2 may be performed

after detecting that the desorption of the adsorbent 52 of an adsorber 5 was completed.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the fuel cell system equipped with the fuel cell which a fuel and an oxidizer are made to react and is generated.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Usually, since a fuel cell is low temperature just behind generation-of-electrical-energy initiation of a fuel cell in a fuel cell system at room temperature extent, the reaction of a fuel and an oxidizer does not progress good and sufficient generation efficiency is not acquired. On the other hand, if this fuel cell generates heat and temperature rises by continuation of a generation of electrical energy of a fuel cell, generation efficiency will improve. Moreover, when the temperature of a fuel cell becomes high too much, there is a possibility that components, such as an electrode, may be damaged.

[0003] On the other hand, in JP,7-94202,A, the fuel cell system which prepared the cooling water circulator which cools a fuel cell, and prepared further the electric heater which can heat cooling water in the middle of this circuit is proposed. In addition, power is supplied to an electric heater from a fuel cell or a dc-battery. According to this, immediately after start-up initiation of a fuel cell, it energizes to an electric heater, cooling water is heated, and a fuel cell can be warmed up with this heated cooling water.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, with the above-mentioned conventional technique, even if it supplied power to the electric heater from the fuel cell and supplied power to the electric heater from the dc-battery, there was a problem that power was needed for an excess by the power supplied to a power heater. This invention was not made in view of the above-mentioned problem, and aims at performing warming up of a fuel cell, without using an electric heater.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned object, when an adsorbent (52) adsorbs an adsorbent object, it is characterized by heating a fuel cell (2) paying attention to emitting the heat of adsorption by this adsorption with the heat of adsorption in the adsorber (5) which equipped claim 1 thru/or 6 with many adsorbents (52) immediately after generation-of-electrical-energy initiation of a fuel cell (2) by invention of a publication.
[0006] According to such a configuration, without using an electric heater, the heat of adsorption by the above-mentioned adsorption can be used, and warming up of the fuel cell (2) immediately after generation-of-electrical-energy initiation of a fuel cell (2) can be performed. Therefore, only the part which does not use an electric heater can plan power saving, and can use the power of a fuel cell (2) effective in the original object. Moreover, in invention according to claim 2, in the generation-of-electrical-energy steady state of a fuel cell (2), an adsorber (5) is heated and desorption of the adsorbent object is carried out from the adsorbent (52) of an adsorber (5) from the heat which a fuel cell (2) generates. Here, in order to warm up a fuel cell (2) immediately after next generation-of-electrical-energy initiation, it is necessary to carry out desorption of the adsorbent object from an adsorbent (52) but, and since this desorption can be performed using the heat which a fuel cell (2) generates, the power activity at this time can be made small.
[0007] Moreover, it can prevent that this fuel cell (2) serves as an elevated temperature unusually, and breakage on a fuel cell (2) can be controlled because a fuel cell (2) emits the heat which self generates to an adsorber (5). Moreover, since the free passage section (55) of an adsorber (5) and a condensation evaporator (6) is closed with a closing motion means (43) after carrying out desorption of the adsorbent object from an adsorbent (52), the desorption condition of the adsorbent (52) of an adsorber (5) is maintainable in invention according to claim 3, as it is till next generation-of-electrical-energy initiation. For this reason, at the time of next generation-of-electrical-energy initiation, by open Lycium chinense, an adsorbent object [in / for the free passage section (55) / an adsorber (5)] can be adsorbed good, and rapid warming up of a fuel cell (2) can be performed good.
[0008] Moreover, in invention according to claim 4, when desorption of the adsorbent object is carried out from an adsorbent (52), it is using the heat of a fuel cell (2) for heating of an adsorber (5), this fuel cell (2) is cooled, and after carrying out desorption of the adsorbent object, the fuel cell (2) is cooled by the condensator (8). Consequently, even after carrying out desorption of the adsorbent object, it can prevent that a fuel cell (2) serves as an elevated temperature unusually, and breakage on a fuel cell (2) can be controlled.
[0009]
[Embodiment of the Invention] Hereafter, the operation gestalt which shows this invention in drawing is explained.
(1st operation gestalt) Drawing 1 shows the fuel cell powered vehicle which uses the fuel cell system 1 of this invention as a power source. The fuel cell system 1 is equipped with the fuel cell 2 which a fuel (hydrogen) and an oxidizer (oxygen in air) are made to react, and is generated, the fuel tank 3 in which a fuel is stored, the fuel pump 4 which sends the hydrogen in a fuel tank 3 to a fuel cell 2, the adsorber 5

for rapid warming up of a fuel cell 2, and the condensation evaporator 6 which is open for free passage to an adsorber 5. These are all prepared in the under floor (vehicle outdoor) of an automobile. And the power from a fuel cell 2 is supplied to the motor 7 for car actuation through the inverter and converter which are not illustrated.

[0010] A fuel cell 2 consists of what carried out the laminating of the fluting connector 21 made from carbon, the positive electrode (cathode) 22 which consists of porous carbon which added the platinum catalyst, electric-field **** 23 which consists of a kneading object of silicon carbide and carbon fluoride which sank in phosphoric acid, and the negative electrode (anode) 24 which consists of porous carbon which added the platinum catalyst to this order, as shown in drawing 2 . Many slots 211 are formed by the field which counters a positive electrode 22 among the fluting connectors 21 at the space perpendicular direction in drawing 2 , and many slots 212 are formed in the field which counters a negative electrode 24 at the space longitudinal direction in drawing 2 at it.

[0011] And air is supplied to a slot 211 from the air pump which is not illustrated, and the hydrogen in a fuel tank 3 is supplied to a slot 212 through a fuel pump 4. And the heat exchange section 25 in which a heat exchange fluid flows is arranged at the fluting connector 21 of the direction edge of a laminating. A fuel tank 3 is the hydrogen storage material 32 five H6 fixed to the interior of a well-closed container 30 around the heat exchange section 31 in which a heat exchange fluid flows, and this heat exchange section 31 (fuel storage alloy), for example, LaNi. It comes to hold. A hydrogen storage material 32 emits hydrogen by carrying out occlusion of the hydrogen, and heating it, or lowering a pressure by cooling or raising a pressure. The pressure in a fuel tank 3 is lowered with a fuel pump 4, and hydrogen is made to emit from a hydrogen storage material 32 with this operation gestalt. In addition, since hydrogen is consumed as a fuel cell 2 is used, occlusion of the hydrogen is periodically carried out to a hydrogen storage material 32.

[0012] An adsorber 5 comes to hold the heat exchange section 51 in which a heat exchange fluid flows, and the adsorbent (for example, silica gel) 52 of the shape of a grain of a large number fixed to the perimeter of this heat exchange section 51 in the interior of a well-closed container 50. By being cooled, an adsorbent 52 adsorbs an adsorbent object (for example, water), and carries out desorption of the adsorbent object by being heated. The condensation evaporator 6 comes to hold the heat exchange section 61 in which a heat exchange fluid flows, and the water W as an adsorbent object in the interior of a well-closed container 60. In addition, the closing motion valve which opens and closes this free passage section 55 in the free passage section 55 of the well-closed container 60 of the condensation evaporator 6, and the well-closed container 50 of an adsorber 5

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the rough whole block diagram of the fuel cell powered vehicle concerning the 1st operation gestalt of this invention.
[Drawing 2] It is the rough perspective view of the fuel cell concerning the 1st operation gestalt.
[Drawing 3] (a) is the inlet temperature T1 of the heat exchange section of an adsorber. And outlet temperature T2 The graph which shows the change to time amount t, the graph which shows change of as opposed to the time amount t of (T2-T1) in (b), and (c) are graphs which show the change to the time amount t of d (T2-T1)/dt.
[Drawing 4] It is the flow chart which shows the actuation concerning the 1st operation gestalt.
[Drawing 5] It is the rough partial block diagram of the fuel cell powered vehicle concerning the 2nd operation gestalt.
[Description of Notations]
2 -- A fuel cell, 5 -- An adsorber, 52 -- Adsorbent.

[Translation done.]